

Claims

What is claimed is:

1 1. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array and a
3 plurality of calendars for scheduling said flows, said scheduling method
4 comprising the steps of:

5 storing an active flow indicator for each calendar entry in a calendar
6 status array (CSA);
7 storing a subset of said active flow indicators from said calendar
8 status array (CSA) in a cache; and
9 updating calendar status array (CSA) based upon a predefined
10 calendar range and resolution; and
11 utilizing said subset of said active flow indicators to determine a flow
12 of a calendar for servicing.

1 2. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 1 wherein the step of storing said active flow indicator for each
4 calendar entry in said calendar status array (CSA) includes the step of
5 storing one bit for each calendar entry in said calendar status array (CSA).

1 3. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 1 wherein the step of storing said active flow indicator for each
4 calendar entry in said calendar status array (CSA) includes the step of
5 storing said active flow indicator for each weighted fair queue (WFQ) ring
6 entry in a calendar status array (CSA).

1 4. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 1 wherein said cache includes a predefined number of bits for
4 storing said cache copy subset for each of the calendars and wherein the
5 step of storing said subset of said active flow indicators from said calendar
6 status array (CSA) in a cache includes the step of utilizing a current pointer
7 (CP) to a calendar entry and loading said subset of said active flow
8 indicators from said calendar status array (CSA) starting at said current
9 pointer (CP) CSA entry and increasing through said predefined number of
10 CSA entries equal to said predefined number of bits.

1 5. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 4 wherein the step of loading said subset of said active flow
4 indicators from said calendar status array (CSA) includes the step of using
5 said current pointer (CP) to determine one of plurality of addressed portions
6 of said calendar status array (CSA) to be accessed.

1 6. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 5 wherein said predefined number of bits for storing said subset for
4 each of the calendars is thirty-two bits and wherein said calendar status
5 array (CSA) includes four addressed portions of one hundred twenty-eight
6 bits of said calendar status array (CSA), each said addressed portion
7 accessible in one cycle.

1 7. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 1 wherein the step of storing said active flow indicator for each
4 calendar entry in said calendar status array (CSA) includes the step for each
5 of said plurality of calendars of storing said active flow indicator for each
6 calendar entry in said calendar status array (CSA).

1 8. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 7 wherein said plurality of calendars include a low latency service
4 (LLS) calendar, a normal latency service (NLS) calendar, and a peak
5 bandwidth service (PBS) calendar and includes the step segmenting each of
6 said plurality of calendars into epochs (0:p), where epoch 0 has a highest
7 resolution and a lowest range; and epoch 1 through epoch p have a range of
8 n(p) times a range of epoch 0; and epoch 1 through epoch p have a
9 resolution of $1/n^{**}p$ times a resolution of epoch 0, where n is a scaling factor.

1 9. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 8 wherein the step of updating said calendar status array (CSA)
4 based upon a predefined calendar range and resolution includes the step of
5 updating said calendar status array (CSA) based upon said predefined
6 calendar range and resolution of said epoch 0 through said epoch p.

1 10. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 8 wherein the step of updating said calendar status array (CSA)
4 based upon said predefined calendar range and resolution of said epoch 0
5 through said epoch p for said low latency service (LLS) calendar, said
6 normal latency service (NLS) calendar, and said peak bandwidth service
7 (PBS) calendar.

1 11. A scheduling method for implementing Quality-of-Service
2 (QoS) scheduling for a plurality of flows with a cached status array as recited
3 in claim 1 includes the step of utilizing said subset of said active flow
4 indicators for incrementing a current pointer (CP) by an identified number of
5 positions up to a current time (CT) value, said identified number of positions
6 equal to a variable number of inactive flow indicators up to said current time
7 (CT) value and said identified number of positions having a maximum value
8 equal to a number of entries in said cache.

1 12. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows comprising:
3 a queue manager;
4 a plurality of calendars coupled to said queue manager for scheduling
5 said flows,
6 a calendar status array (CSA) coupled to said plurality of calendars
7 for storing an active flow indicator for each calendar entry for each of said
8 plurality of calendars;
9 a cache coupled to calendar status array (CSA) for storing a cache
10 copy subset of said active flow indicators from said calendar status array
11 (CSA); and
12 a calendar updating algorithm for updating calendar status array
13 (CSA) based upon a predefined calendar range and resolution; and
14 said queue manager for utilizing said cache copy subset of said active
15 flow indicators to determine a flow of a calendar for servicing.

1 13. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 12 wherein plurality of
3 calendars include a low latency service (LLS) calendar, a normal latency
4 service (NLS) calendar, and a peak bandwidth service (PBS) calendar.

1 14. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 12 wherein said
3 calendar updating algorithm for updating calendar status array (CSA) based
4 upon a predefined calendar range and resolution includes segmenting each
5 of said plurality of calendars into epochs (0:p), where epoch 0 has a highest
6 resolution and a lowest range; and epoch 1 through epoch p have a range of
7 n(p) times a range of epoch 0; and epoch 1 through epoch p have a
8 resolution of 1/n*p times a resolution of epoch 0, where n is a scaling factor.

1 15. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 14 wherein said
3 calendar updating algorithm for updating calendar status array (CSA) based
4 upon a predefined calendar range and resolution is based upon a priority of
5 said low latency service (LLS) calendar, said normal latency service (NLS)
6 calendar, and said peak bandwidth service (PBS) calendar and a number of
7 said epoch.

1 16. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 14 wherein said
3 calendar updating algorithm for updating calendar status array (CSA) based
4 upon a predefined calendar range and resolution accesses said calendar
5 status array (CSA) by an ascending order said epoch for each of said
6 calendars in an order of said low latency service (LLS) calendar, said normal
7 latency service (NLS) calendar, and said peak bandwidth service (PBS)
8 calendar.

1 17. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 14 includes a current
3 pointer (CP) to determine one of a plurality of addressed portions of said
4 calendar status array (CSA) to be accessed in a system cycle.

1 18. A QoS scheduler for implementing Quality-of-Service (QoS)
2 scheduling for a plurality of flows as recited in claim 14 includes current
3 pointer (CP) incrementing means utilizing said cache copy subset of said
4 active flow indicators for incrementing a current pointer (CP) by an identified
5 number of positions up to a current time (CT) value, said identified number of
6 positions equal to a variable number of inactive flow indicators up to said
7 current time (CT) value and said identified number of positions having a
8 maximum value equal to a number of entries in said cache.

1 19. A computer program product for implementing Quality-of-
2 Service (QoS) scheduling of a plurality of flows with a cached status array
3 and a plurality of calendars for scheduling said flows in a scheduler, said
4 computer program product including a plurality of computer executable
5 instructions stored on a computer readable medium, wherein said
6 instructions, when executed by said scheduler, cause said scheduler to
7 perform the steps of:

8 storing an active flow indicator for each calendar entry for each of said
9 plurality of calendars in a calendar status array (CSA);
10 storing a subset of said active flow indicators from said calendar
11 status array (CSA) for each of said plurality of calendars in a cache; and
12 updating calendar status array (CSA) based upon a predefined
13 calendar range and resolution for each of said plurality of calendars; and
14 utilizing said subset of said active flow indicators for each of said
15 plurality of calendars to determine a flow of a calendar for servicing.

1 20. A computer program product for implementing Quality-of-
2 Service (QoS) scheduling of a plurality of flows with a cached status array
3 and a plurality of calendars for scheduling said flows in a scheduler as
4 recited in claim 19 wherein said instructions, when executed by said
5 scheduler, cause said scheduler to perform the steps of utilizing said subset
6 of said active flow indicators for incrementing a current pointer (CP) by an
7 identified number of positions up to a current time (CT) value, said identified
8 number of positions equal to a variable number of inactive flow indicators up
9 to said current time (CT) value and said identified number of positions having
10 a maximum value equal to a number of entries in said cache.